

Applications of Electricity.

- (1) *Telephonic Transmission: Theoretical and Applied.* By J. G. Hill. (Manuals of Telegraph and Telephone Engineering.) Pp. xvi+398. (London: Longmans, Green, and Co., 1920.) Price 21s. net.
- (2) *The Principles of Electrical Engineering and their Application.* By G. Kapp. Vol. ii., *Application.* Pp. viii+388. (London: Edward Arnold, 1919.) Price 18s. net.

(1) **T**HE applications of electricity in the telegraph and telephone services are now so numerous and so highly specialised that no one can claim to have an expert knowledge of every branch. It has been decided, therefore, to produce a series of handbooks which will cover the whole of the ground involved. The editor of the series is Sir William Slingo, late engineer-in-chief of the Post Office, and most of the authors are on the staff of the Engineering Department. Judging from the present volume and from the names of the authors preparing the other volumes of the series, we shall soon have a very complete and thorough account of English telegraphic and telephonic practice.

This book is written for experts engaged in the practical applications of telephony, and must be judged from this point of view. It is now ancient history how the early telephonists did their best to diminish the capacity and resistance of their lines with the object of securing good communication. In 1887 Oliver Heaviside pointed out that this rule was quite fallacious. The two qualities of the line which it is necessary to study are the attenuation of the signals and the velocity with which they are propagated. Heaviside stated this clearly and showed that his "distortionless" circuit gave the complete solution of the problem. In 1900 Prof. Pupin showed how a distortionless circuit might be secured very approximately by putting inductance coils at certain intervals in the line. When the distance between the coils is small there will be little reflection of the waves by them, and in this case the practical working will be satisfactory.

There are many engineers employed in telephone work who have great difficulty in following the advanced mathematical reasoning of Heaviside and Pupin, and yet they have to evaluate their complicated formulæ in everyday work. For their benefit the author introduces additional chapters describing the transmission of direct currents along a leaky line and getting the equivalent circuits. This should give those engineers confidence to attack the complete mathematical problem which is given in appendices.

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The symbols and general arrangement of the formulæ are mostly those used by Kennelly and Fleming, whose work is much appreciated by the British Post Office. To the general man of science most of the book will appear to be endless variations of complicated formulæ, involving complex variables, deduced from comparatively simple differential equations. But a study of the book will show him how laborious it is to get numerical solutions, and how ingenious are some of the methods employed to get the constants of the line. The chapter on "the human voice in telephony" is illustrated by excellent oscillograms of the alternating currents produced by certain words. There is also a chapter on the thermionic valve as a telephonic relay which is of great interest. Very instructive characteristic curves of the valve are shown. A curve is also given which proves the enormous variation of magnification with input. The use of these telephonic relays is most promising, and great developments may shortly take place.

The book will be of great value to the telephonic engineers for whom it is written. We were much interested in the electrical constants of many of the cables used in practice which have been calculated by the author. They prove conclusively the great value of advanced mathematical theory in telegraphy and telephony.

(2) As a pioneer of the applications of electricity Prof. Kapp has had the pleasure of seeing many of his theorems become incorporated in the routine teaching of technical colleges and many of his methods widely adopted in everyday practice. The technical student, therefore, will find much that is familiar in this volume; but he will also find that the proofs given in many cases have been appreciably simplified. The author invariably keeps practical considerations in the foreground and rarely, if ever, digresses on points of abstruse theory. In discussing the running of machines he makes little endeavour to elaborate the theory, but gives, in most cases, a clear first approximate solution. The book, therefore, will be welcomed by the engineer and the student. The former will gain a clearer view of the principles on which his machines work, and the latter will find that many long mathematical solutions can be much shortened by elementary graphical methods.

In the earlier chapters direct-current machinery is described. The treatment of the critical speed of turbo-dynamos is very neat, and the results agree with experiment. Little space is given to losses which are relatively unimportant—bearing friction, for instance. The methods of coupling dynamos for parallel running are fully described.

A clear description of the Thury system of direct-current high-tension transmission is given. There seems to be little chance, however, of this system being adopted on a large scale in this country. Chap. v. describes the uses of a storage battery in connection with a dynamo. Brief descriptions of the various types of booster used in this connection are given and will be helpful to the student.

In chap. vii. a brief reference is made to Fourier's theorem. The coefficients are obtained by drawing the graphs of curves the equations of which are of the form

$$y = f(x) \cos(2\pi nx/\lambda),$$

and then getting their area by the planimeter. Although theoretically correct, we think that the method would prove laborious in practice. We think also that the error for high harmonics would probably be large, as the planimeter reading gives the difference between many areas.

The author suggests that large choking coils should be constructed in the form of a toroid, the diameter of the circular cross-section of which equals $0.311D$, where D is the mean diameter of the toroid. This is Maxwell's solution for the most economical coil; and the author has found practically that the expression $9.35n^2D$ gives its inductance, where n is the number of turns. This is in good agreement with Maxwell's formula, $3\pi n^2D$ —i.e. $9.43n^2D$. It has to be remembered, however, that Maxwell's formula is only a rough approximation. If we use Rayleigh's formula we get $9.69n^2D$ for the inductance. The 4 per cent. difference between theory and experiment is probably due to the assumption that the current is uniform all over the cross-section of the toroid. If we use Rayleigh's formula it will be found that we get very appreciably different dimensions for the most economical choking coil.

The discussions of parallel running, transformers, converters, and induction and commutator motors are all instructive and suggestive. The last chapter, on phase advancers, is a strong and convincing plea for their more general adoption in practice. Considerable economies can be effected by their use.

A. RUSSELL.

British Iron Ores.

The Iron Ores of Scotland. By M. Macgregor, Dr. G. W. Lee, and G. V. Wilson. With contributions by T. Robertson and J. S. Flett. (Memoirs of the Geological Survey, Scotland: Special Reports on the Mineral Resources of Great Britain: Vol. xi. *Iron Ores (continued).*)

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Pp. vii + 240. (Edinburgh: H.M.S.O.; Southampton: Ordnance Survey Office.) Price 10s. net.

THE present volume forms a continuation of the important series of memoirs on the iron ores of Great Britain which the Geological Survey has been issuing for some time past. Unlike some of the previous ones, the subject here discussed affords little scope for original geological investigations, the principal deposits of iron ore being very well known and having often been described. As is, however, very truly remarked by Sir Aubrey Strahan, the information concerning them is scattered throughout a large number of publications, and it is a great advantage to the student of the subject to have it all brought together in one volume. The authors have done their work carefully and painstakingly, and the result of their labours has been to render available a very complete and minutely accurate record of the known Scottish iron-ore deposits.

The book is divided into seven chapters. The first gives an introductory and historical account of the subject, containing much interesting matter; attention should, however, be directed to a mistake as to the nature of the old Catalan furnace. The author writes: "These furnaces were of the Catalan type, . . . and castings were apparently made direct from the furnace itself." These two statements are incompatible, for the essential feature of the Catalan process was that it produced malleable iron, and not cast iron, direct from the ore.

The next four chapters are devoted to the bedded iron ores of Carboniferous age, these being subdivided mainly according to their geographical distribution. In a sixth chapter the bedded Raasay ironstone of Jurassic age is described, and in the last chapter a number of minor occurrences, which are grouped together under the heading "Hæmatite in Veins and Beds"—a somewhat infelicitous title, seeing that true hæmatite is conspicuous by its absence.

As in the previous volumes of the series, the least satisfactory portion of the present one is that relating to the estimated tonnage of ore reserves. It ought to be made thoroughly clear that the tonnage of ore as estimated by a geologist represents a quantity many times greater than that which the miner can hope to recover in actual practice. The iron industry of Scotland requires some $2\frac{1}{2}$ million tons of ore annually, about one-fifth of which is obtained from native Scottish deposits, and it is poor consolation to the Scottish ironmaster, who for a good many years past has